EVAPOTRANSPIRATION SYSTEMS

Description. A sand and gravel bed contained within an impervious lining, which receives septic tank effluent and in which evapotranspiration through the surface of the sand and/or plant life is the sole means of effluent removal.

Conditions for Approval.

1. The site must not be subject to flooding.
2. High groundwater, seasonal or normal, must not come within six (6) inches of the bottom of the impervious liner.
3. Evapotranspiration systems may be approved where soils are very thin, impermeable or very coarse.
4. The adjusted growing season (March-October) evapotranspiration at the site must exceed the ten year return frequency annual precipitation.
5. The slope must not exceed twelve (12) percent.
6. The setback from surface water may be reduced to 100 feet if the system is constructed with a minimum of a 60 mil PVC or HDPE liner.
7. The ET System must have a minimum of 100 feet separation to any Domestic or Public well.

Design.

1. Area: $T_{area} = nV/(GS_{ET} - P)$

   Where:

   T_{area} = Total horizontal area in square feet.

   n = Peaking factor, varies from 1 to 1.6, per EPA/625/R-00/008, TFS-31. (see references)

   V = Annual volume of received effluent, in cubic feet.

   GS_{ET} = Annual growing season (March-October) reference evapotranspiration, adjusted for the vegetation planted on the bed, in feet per square feet.

   P = Annual precipitation with a return frequency of 10 years in feet per square feet.

2. Total Bed Depth (T_{bd}). Total Bed Depth will be determined from a water mass balance beginning with October (See form at the end of this section). No credit is given for evaporation occurring between November and February.
   a. The total bed depth includes:
      i. The vertical distance from the ground surface to the bottom of the laterals which should be no greater than 1 foot plus the lateral pipe diameter.
      ii. The vertical distance from the bottom of the laterals to the highest calculated saturated effluent depth which should be no less than 0.5 feet.
      iii. The total vertical distance from the ground surface to bottom of the impermeable liner should not exceed 4 feet.

   See Evapotranspiration Cross-Section diagram below.

3 A high water alarm shall be installed. This high water alarm shall indicate when the effluent level in the ET System reaches the bottom of the laterals. The alarm shall be both audible and visible. The alarm relay shall be latching, requiring the owner/operator/service personnel to physically inspect the effluent level in order to reset the alarm.

System Sizing Procedure.

(A) Determine annual precipitation with a ten year return frequency using annual precipitation data from Idaho Climate at http://www.wrcc.dri.edu/summary/climsmid.html in feet per month. The frequency analysis can be done using the log Pearson III method described at: http://water.oregonstate.edu/streamflow/analysis/floodfreq/index.htm#log. A web-based calculator for this method can be found at:
http://octavian.sdsu.edu/~ponce/pearson/pearsonform.html
The monthly precipitation distribution can be obtained using the long-term monthly averages for the climatological site in question along with the long-term average annual precipitation. The monthly precipitation distribution and calculated annual precipitation are then used to calculate monthly precipitation rate (A).

(B) Effluent Depth = days/mo. * daily flow, in cubic feet/month/surface area.

$B = gal/day * days/mo * 0.1337\ ft^3/gal\ /(T_{area}\ ft^2)$.

(C) Determine evapotranspiration in feet per month from average growing season (March-October) reference evapotranspiration (ETr) for the station nearest the proposed project. Resources which provide this information include the Agrimet network at:
http://www.usbr.gov/pn/agrimet/monthlyet.html
and the Kimberley Research and Extension station for the University of Idaho at:
http://www.kimberly.uidaho.edu/water/appndxet/index.shtml
The ETr value should be adjusted for the water use efficiency of typical plant species used on the ET bed by multiplying by the crop coefficient of 0.7:

$C = 0.7*ETr$

(D) Δ Storage = effluent depth + [precipitation - $evapotranspiration_{adjusted}$]:

$D = B + (A - C)$

(E) Determine the cumulative storage by adding each previous month.

$E = D_{Oct} + D_{Nov} + ... + D_{Sept}$

Determine E_{max}, the largest value of cumulative storage needed during the annual cycle.

(F) Determine the total bed depth to prevent overflow. Calculate the saturated bed depth (F). Since the bed is filled with sand, the total bed is not available for storage. An average holding capacity of thirty five (35) percent should be used. The Saturated Bed Depth (ft):

$F = E_{max}/0.35$

(G) Finally, calculate the total bed depth, T_{bd} , by adding the minimum vertical distance from the top of the maximum saturated bed depth to the ground surface to the saturated bed depth (F). If the total bed depth is greater than four feet then the area of the ET bed should be increased to add the required volume in order to keep the ET bed maximum depth at 4 feet or less.

Construction.

1. An appropriately sized septic tank must be placed prior to the ET System to provide primary clarification.
2. The bed must be lined with an impervious liner approved by the Department. Synthetic liners must be imbedded in sand, free of sharp stones, with at least four (4) inches of bedding sand between the liner and the natural soils. The liners must be bonded per manufacturer's recommended procedures.
3. The bed is filled with modified ASTM C-33 sand, the modification is the exclusion of all materials passing the 100 sieve. The sand should be crowned at two (2) to three (3) percent

to establish a slope for precipitation and snow melt runoff.

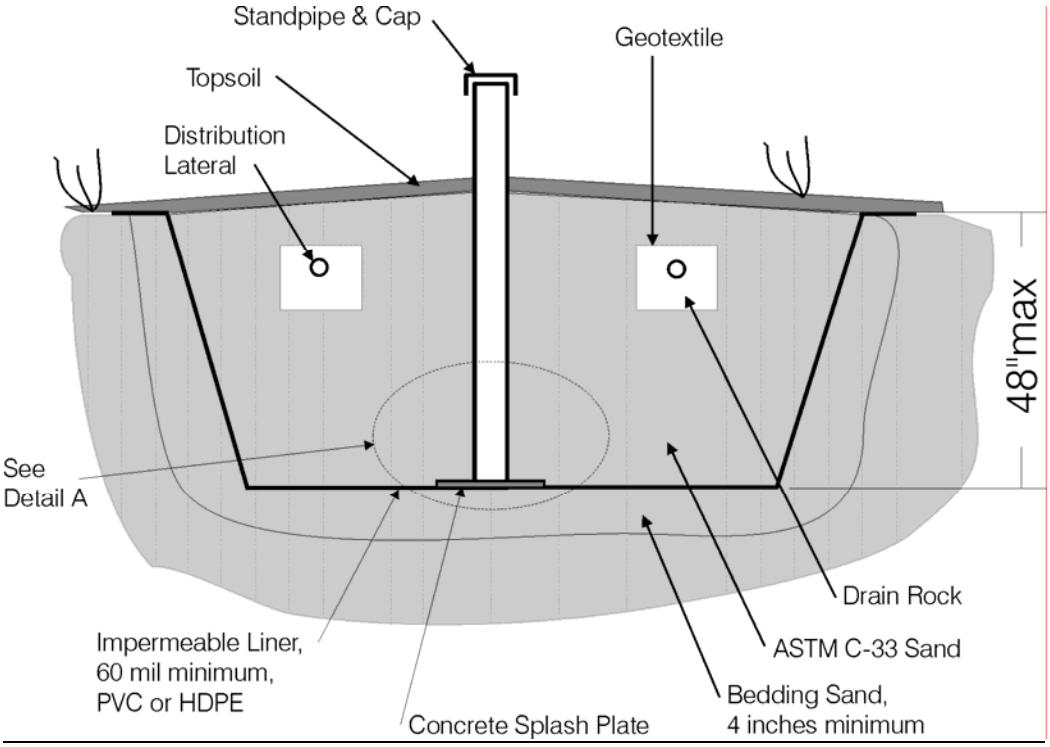
4. Distribution laterals must be placed in one (1) foot by one (1) foot drain rock trenches constructed in the sand layer. The piping should be looped, and spaced in order to provide uniform effluent distribution.
5. The drain rock shall be wrapped in Geotextile.
6. A four (4) to six (6) inch layer of sandy loam topsoil must be placed directly on the sand of the bed, matching the slope specified for the modified ASTM C-33 sand.
7. An eight (8") inch minimum diameter standpipe shall be installed in the center of the bed. The standpipe shall extend down to the splash plate and shall extend above the topsoil a minimum of six inches. The purpose of the standpipe is to monitor effluent levels in the bed, provide access for maintenance pumping to reduce the salinity levels in the bed, and to provide access for emergency situations to prevent surfacing of effluent. If the ET System has an Aspect Ratio (AR), which is the ratio of length (L) to width (W), greater than two (2), then multiple standpipes will be required so that the distance separating each standpipe does not exceed the width of the ET System, and the number of standpipes required is an equal multiple of the width (W).
8. the ET System's liner must be leak tested after inserting the modified ASTM C-33 sand. The liner must pass the leak test in order to successfully pass the final inspection and receive authorization to be put in used by the Health District.
9. The finished bed should be planted with a combination of both shallow and deep rooting perennials. The species chosen, particularly the deep-rooted species, should be tolerant of elevated salinity levels. Small, salt tolerant shrubs are acceptable, but large trees and other deep rooted plants are prohibited. Plants shall be planted prior to system use, and according to an acceptable planting schedule that will minimize plant die-off due to lack of water, excessive heat or cold, or other detrimental condition.
10. The ET System should be fenced, or placed in a location that prevents small children or pets from accessing its surface.

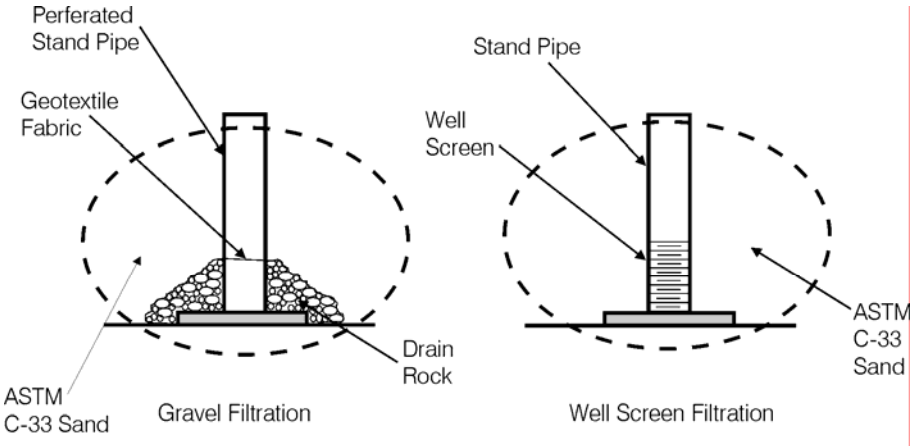
Operations & Maintenance Requirements.

1. Fertilizing the ET system is not required.
2. Irrigation of the ET system is not required, but may be allowed during prolonged droughts or periods of excessive heat to maintain a healthy plant population. At no time should irrigation become a significant contributor to the liquid in the system.
3. Monthly monitoring and recording of the ET System's effluent depth is required for the first year. Subsequent years can be monitored and recorded on a quarterly basis. Annual data shall be submitted to the appropriate Health District.
    a. Unexpected effluent depth shall be immediately reported to the Health District. The Health District shall assist the owner in finding the appropriate corrective action.
        i. A lack of effluent may indicate a leaking system.
        ii. Excessive effluent, indicated by the alarm activating multiple times, may indicate excessive water usage, leaking toilet, or irrigation of the system.
4. Periodic surface maintenance may be required.
    a. In the summer, if the surface contains grasses, they should be mowed periodically, and the clipping removed and disposed of with other yard refuse.
    b. Autumn maintenance may include gently spreading leaves over the surface, and allowing the resident flora to die back. Removal of the refuse is not necessary. A thin layer of leaves will provide a thermal blanket that will keep the ET System from freezing during the winter.

c. No maintenance is foreseen for winter operation.
d. Spring maintenance may require removal of cover to allow the new growth the best opportunity to access light.

5. A pool test kit may be used to monitor effluent salinity. It is recommended that salinity tests be conducted at the end of the summer or early autumn. Record the value along with the effluent depth. Plants showing signs of stress may indicate excess salinity in the ET System.
6. Periodic pumping and flushing of the ET System may be required to prevent excessive build up of salinity. Excessively saline soils will inhibit plant growth, and could reduce evaporation from the ET System. The ET System should be pumped concurrently with the septic tank maintenance every three (3) to seven (7) years.





Detail A

SAMPLE WATER MASS BALANCE

Month	Precipitation Rate	Effluent Depth	ET	Δ Storage	Cumulative Storage	Saturated Bed Depth
	A	B	C	D	E	F
Oct.						
Nov.						
Dec.						
Jan.						
Feb.						
March						
April						
May						
June						
July						
Aug.						
Sept.						

Start with the first month in which storage will be positive. In Idaho, that is usually October.

Notes.

1. Ion Exchange Water Softeners, those that use Salt (Sodium or Potassium Chlorides), are not recommended for discharge to ET Systems due to excessively quick salt buildup. If water softeners are used in the home, pumping and flushing of the ET System may be required as often as every other year to prevent stressing the plants, and building up an impermeable salt layer inside the ET System.
2. Unless the net evaporation (the difference between total precipitation and evaporation) is very large, evapotranspiration systems may be impractical. At Kuna, Idaho, where the net evaporation is 25 inches per year, a system for a three-bedroom home may exceed 5000 square feet and have a diameter exceeding 80 feet.
3. No substantiating evidence is currently available to support reduction of ETA design below that which is provided herein.
4. Contact the NRCS or University of Idaho Agricultural Extension for recommended plants for populating the ETS surface.

References

Bennett, Edwin R. and K. Daniel Linstedt. 1978. Sewage Disposal by Evaporation-Transpiration. United States Environmental Protection Agency. Office of Research and Development. EPA-600/2-78-163. September 1978

California Department of Water Resources. 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California. The Landscape Classification Method and WUCOLS III.. University of California Cooperative Extension. August 2000.

EPA (February, 2002) Onsite Wastewater Treatment Systems Manual, Technical Fact Sheet 6, EPA/625/R-00/008, TFS-31.